Asymmetric Warfare in the Simulation and Training Environment: Comprehensive Approach Wanted!

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ABSTRACT

Traditionally, the military has used live simulation as a primary means of training. With the high cost of such training and the growing shortage of adequate space for its conduct, constructive simulation and, more recently, virtual simulation have become increasingly important. The convergence of Live (real people and equipment but simulated results), Virtual (Real people but simulated equipment and environment) Constructive (Simulated people, equipment & environment, stimulated by real people) known as LVC simulation, provides the military (and others) with the ability to "mix and match" simulation methodologies to meet both the training objectives of the commander and the constraints (time, space, cost) imposed by the training context.

1.0   INTRODUCTION

Since the end of cold war, military forces have been dealing with a new challenge: the rapid deployment of forces in usually hostile territories in order to participate in peacekeeping or force projection operations or to assist international organizations and non-governmental organizations engaged in human relief operations. These types of operations widely addressed as Peacekeeping Operations (PO) or better Peace Support Operations (PSO) especially in the settings of an urban environment, are posing significant challenges in the entire decision making, mission planning and mission execution cycle.

The characteristics that affect the aforementioned cycle are; the Operational Area, which is characterized by complex, ambiguous, and, at times, uncertain situations that may have some or all of the following: asymmetrical threats, failed states, absence of rule of law, gross violations of human rights, collapse of civil infrastructure or presence of displaced persons and refugees. The second characteristic, the Risk Management is a key topic. Leaders at every level must endlessly assess the risk to their forces and take appropriate actions to mitigate that risk. In addition, during early stages of deployment, military units may be required to conduct non-traditional military operations.

And finally, PSO are unique, with their own political, diplomatic, geographic, economic, cultural, and military characteristics.

2.0   PRESENT SITUATION: BAD TIMES OVER?

The fundamental concept of simulation dates back thousands of years to the ancient Egyptians and the famous Chinese war strategist Sun Tzu. Notwithstanding these initial attempts to replicate ancient battlefields, current day machine-based modelling and simulation (M&S) found its roots in the early 20th century. During this dawning era, the majority of M&S efforts were carried out in isolation. It is a fact one

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Traditionally, the military has used live simulation as a primary means of training. With the high cost of such training and the growing shortage of adequate space for its conduct, constructive simulation and, more recently, virtual simulation have become increasingly important. The convergence of Live (real people and equipment but simulated results), Virtual (Real people but simulated equipment and environment) Constructive (Simulated people, equipment & environment, stimulated by real people) known as LVC simulation, provides the military (and others) with the ability to "mix and match" simulation methodologies to meet both the training objectives of the commander and the constraints (time, space, cost) imposed by the training context.

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may not find so surprising considering the fundamental definition of a model: a representation of an element of the real world for a specific purpose.

Working in isolated domains on specific applications, M&S developers created bespoke solutions to precise problems, but with the evolution of networks and networked computer systems where modelling and simulation has undergone a significant maturation process over the past few decades. Early on, the M&S realm represented only a very small portion of the real world. Systems such as flight simulators, and Operational Analysis (OA) models, although based on real world requirements, had no direct physical connection to the real world domains. Technology growth led to an expansion within the M&S realm, allowing practitioners to address a larger subset of real world applications with more comprehensive and complex representations.

These components of the Live, Virtual and Constructive Simulation (LVC) can be divided into two categories: those associated with the science and technology of simulation itself and those more closely related to the human and cultural aspects of the M&S community. Considering the science and technology of simulation modelling, the Urban Battlefield environment is the most important challenge especially thanks to the existence and modelling of buildings, which remain by far the most important feature in the urban environment.

In most of the cases even in advanced simulators buildings resolution and representation is not adequate for enhanced perception of the environment, especially when dealing with multi-level building and subterranean structures. Referring to human and cultural aspects of urban environment, in most of the cases existing simulators do not support complex interactions with civilians and crowd during simulations, and impact of urban warfare to the friendly personnel due to the fact that urban warfare is exceptionally fatiguing both physically and mentally, as well as dangerous and it provokes highly destructive, stressful, high intensity close combat that leads to significant logistical and medical challenges.

3.0   ASYMMETRIC OPERATIONS: URBAN TERRAIN PREVAILS

The characteristics mentioned in the previous section are amplified whenever PSO are conducted in urban environment. Urban terrain is a complex, man-made environment unlike the terrain in which soldiers have traditionally trained for combat. It is characterized by three subsystems: physical, functional and social. Physically, urban terrain comprises of angular forms laid out in a grid pattern with a lot of cover and frequent, regular, channelled fields of fire and killing grounds. Buildings may be of many styles within one urban centre.

It is three-dimensional space, where the vertical dimension is of great importance. The vertical dimension not only provides extreme barriers to assault, but it also provides the defence with a man-made form of high ground and often also with a subterranean level for combat by way of cellars and sewers.

The force in possession of this terrain, especially with time to prepare defences, has a distinct opportunity to reduce any disadvantages that it may have compared to the attacking force. In particular, it usually forces the combatants into small unit engagements at close range. The urban terrain's non-physical environment is also very important. The functional subsystem represents the lifeblood networks of the city, such as transport, communications and utility networks. These networks permit the inhabitants to thrive and the enemy to survive.

Modern cities have formal subsystems characterized by centralized administration, industrial or post-industrial technologies, links and nodes. Whereas, primitive cities normally contain informal decentralized subsystems in which primitive or adaptive technology predominates, with patterns of individual and small

group activity. If there are any nodes in primitive cities, they are highly decentralized. The social subsystem represents the human dimension, the culture, demographics, religion, and history of the urban setting. This is perhaps the most difficult subsystem to grasp because it is usually such a complex, interwoven network of factors. Culture is a particularly powerful influence. Culture relates to the way in which definable groups of people interact with their social and physical environment. It helps to define a group, especially in relation to other groups.

This applies to nations, races, religions, tribes, clans, professions, in fact to any group. Culture consists of learned behaviours arising from shared knowledge and it is passed on from one generation to the next. The behaviours that have become embedded as part of a group's culture are those that helped to ensure the group's survival in the past. Culture is reflected in the group's values, beliefs, rituals, symbols and behaviours. While culture changes, the change is usually slow, particularly in terms of military operations timeframes. Urban environments and foreign cultures can be complex terrain for the conduct of military operations. For the NATO military forces, for example, missions involving urban operations have so far been carried out on non-NATO member's soil, and this is probably the case for the foreseeable future.

This presents the potentially stressful prospect of operating in a complex, unfamiliar physical, political and social environment, perhaps a long way from home, and among a large population of non-combatants. Sometimes the non-combatants might be unfriendly. Often it may be difficult to identify friend from foe in the close-range encounters that might occur in urban areas. The structure of urban terrain provides good cover and many observation posts. These together with the presence of a large number of non-combatants have a significant restricting influence on the soldiers' traditional approach to fire and movement during the assault.

Small groups, down to section and even half-section will frequently be the unit of operation in the urban environment. There may also be other arms attached as part of the fighting teams. The structure and construction of urban terrain can be expected to have a significant negative effect on the command and control of urban operations. Fields of observation could be restricted and communication and navigation severely disrupted.

The disrupted communications and navigation will create problems calling in fire support. It will also mean that the transmission of intelligence, both up and down the chain of command, will be disrupted. The operational tempo will be high, reducing the timeframe for decision making and reacting. Units may frequently become disoriented or confused. This may increase the stress for soldiers and the chances of significant human errors, such as firing on friendly forces or non-combatants. All of these factors make it more difficult for senior leaders (company, battalion, regiment, brigade commanders) to keep up to date with the progress of the battle, and may make it more difficult than in non-urban warfare for these leaders to provide feedback to operational and strategic commanders.

Urban terrain amplifies the ease and effectiveness of deception and leads to short range engagements with little time for preparation. It makes it difficult to identify friend from foe thus increasing the likelihood of fratricide. Casualty rates are very high, and ammunition and other supplies are consumed at a very high rate. Use of some weapons, designed for open space deployments, may be problematic in urban terrain, e.g. barrel depression or elevation on armoured vehicles and artillery. Coordination of air attacks, either for lodgement of forces or fire support may also be difficult. GPS may be blocked and radios will only work over shorter ranges making coordination and navigation difficult. Urban warfare is dangerous and exceptionally fatiguing (both physically and mentally). It provokes highly destructive, stressful, high intensity close combat, which often leads to significant logistical and medical challenges.

3.0   PROPOSED SOLUTIONS ENVISAGED

The key objective of the Comprehensive Integrated Simulation and Training System is the development of an integrated environment for mission planning, training and rehearsal for both staff and field personnel on tactical and operational level suitable for the modem Asymmetric Warfare using Commercial on the Shelf (COTS) technology.

Having considered the incoherent present simulation and training conditions and platforms we propose following modification and improvements in order to set up comprehensive integrated simulation and training system comprising these elements:

- An integrated scenario building environment allowing for implementation of the concept of the User Defined Operational Picture (UDOP), which should be a consistent tool of the simulation toolbox of elements. Through customized user interface, the user will be able to determine the "What/When/How" of the presentation of available information. Most importantly, this environment will allow users to combine high-resolution imagery, real-time asset tracking, geospatial analytic tools, live video feeds and many other operationally relevant capabilities into one common 3D visualization interface, saving the user critical minutes "lost" in switching between applications inherent in current real and simulated Command and Control systems. The envisaged engine will be the starting point for interacting with other integral engines.

- The proposed simulations engines, should allow for the selection of different Man Machine Interfaces/Human Machine Interface (MMI/HMI) to demonstrate and test different interfaces and test their suitability and effectiveness during training in asymmetric environment.

- Modelling of Simulated entities as crowd, friendly, enemy personnel, weapons, explosions, will make it possible to review existing models of the aforementioned entities and will integrate them to both Virtual Reality and Operational Network environment.

- Communication and Interaction between entities at different simulation environments as C2, augmented reality, and war gaming interface will investigate the use of real communication and sensing equipment over suitable connectors. This approach provides significant advantages because the users work with equipment which is exploited in real actions on real terrain and there is no need for modelling traffic sources to deal with real data transfers between participants.

- Unified environment for After Action Reports (AAR) will allow the investigation of the trainees and or plan performance against predefined targets. The debriefing environment will support multilevel views and replays of the scenario played during the simulation. Furthermore the engine will provide instructors and trainees with meaningful reports considering their performance.

These elements should encompass a C2 and mission planning environment empowered by a 3D GIS environment (3D buildings) with blue and red tracking capabilities, a scenario building Engine, an Augmented Reality platform for enhanced situation replication, a Virtual World Multiplayer environment capable of realistic virtual representation of participants based on behaviour modelling (representing soldiers, coalition forces, terrorists, OPFOR, and non-combatants, crowd), real-time communication between participants such as staff-field, vehicles, aircraft, and weapons, health management, computer-generated entities to populate the environment, environmental effects and an after action review system.

To this aim, the measurable improvements within the user-friendly simulation environment to the harsh requirements of urban operations are foreseen, especially to the following areas such as Scenario Building Environment, Human Machine Interface, Interaction and Description of Ambient Entities/Environment,

Modelling of Simulated entities (Crowd, friendly, enemy personnel, weapons, explosions, etc), Interaction/Communication between entities at different simulation environments (C2, augmented reality, and war gaming interface) and Fusion of Information gathered from sensors.

4.0 CASE STUDY: COMPREHENSIVE INTEGRATED SIMULATION AND TRAINING CENTRUM

The basic concept establishes a simulation facility with a modular design that allows the interchange of equipment, software, tools, and protocols without requiring significant development. The Comprehensive Integrated Simulation and Training Centrum (CISTC) is equipped with standard simulation tools and equipment that are necessary in the planning, execution, and review phases of an exercise. These tools support training for Command and Staff and the development of doctrine, training, tactics, and equipment. The CISTC contains a Simulation Software Engine (SSE), Stealth Viewer, Virtual Simulator, Data Logger, and an After Action Review capability. Additional CISTC features include Video Tele-Conferencing (VTC), Distributed Interactive Simulation (DIS) capability, and a migratory path to continually evolving computer technology. All functions are satisfied with commercial hardware and software that are compliant with industry practices and standards.

CISTC performance can be enhanced by the incorporation of host specific weapons effects, vehicles and behavioural characteristics into SSE. Virtual and Live training systems can also be included to increase the realism of the combined arms battlefield. The CISTC is capable of incorporating available virtual simulations (weather, chemical effects, equipment performance, etc.) and simulators (M1, Bradley, T-72, etc.). The CISTC can be tailored to meet command requirements and still be interoperable with other DIS and High Level Architecture (HLA) compliant federations or simulations.

The CISTC package provides a Training Support Plan (TSP), hardware (when required), and software necessary for a complete site operation. The CISTC also includes a site survey and planning activities necessary to transform regular classrooms or training facilities into a computer-aided training and exercise facility that is tailored to meet the requirements of the host element.

The TSP will provide an Exercise Planning tool to develop training exercise materials and manage exercise data at the collective training task level. An example is the Training Exercise Development System (TREDS) tool that is useful when developing exercises in any collective training environment – Live, Virtual, or Constructive. TREDS develops the Operations Order (OPORD). The OPORD is then input into the constructive simulation. Such training provides the tools and experience to plan an exercise, develop the scenario and implement it in SSE, and execute the exercise. The TSP also includes training using provided simulation tools, exercise planning and execution, data recording and implementation into an After Action Review and hardware operation.

The provision of this training package establishes a resident knowledge base and channels it into the operation and functions of all CISTC systems. It is also the key to rapid and successful establishment of each centre. CISTC exercises start with small, simple exercises and then develop into large, complex exercises utilizing all of the CISTC tools and simulation equipment greatly reducing the time required to make a simulation facility function effectively. The basic CISTC hardware is commercially available computer workstations. Individual site requirements and their current hardware and software tools are considered prior to determining the CISTC hardware requirements for a new location. This allows the CISTC costs to be controlled through the use of existing hardware and software and tailoring the size of the simulation capabilities. Currently, the CISTC simulations and exercise development tools are DIS compliant or have migrated to HLA standard.

The basic CISTC provides for Friendly and Opposing Forces, Exercise Control, Aviation, Air Defence, Artillery, and Logistics. CISTC provides all site-specific requirements and includes the equipment necessary for connection to long haul networks. The receiving host must provide the long-haul line or satellite communication links.

Each CISTC contains Semi-Automated Force (SAF), Stealth, Virtual Simulator, Data Logger and After Action Review (AAR) capabilities. These functions are needed to provide basic simulation components necessary to execute a combined arms exercise. The CISTC utilizes Personal Computer (PC) based simulations and tools to offer the highest performance at the lowest cost approach. This PC workstation approach provides flexibility, low cost maintenance, ability to perform multiple functions, easy upgrade potential and utilizes existing computer operator skills.

The SSE provided is a more automated version of Computer Generated Force (CGF) that provides automated behaviours for modelled equipment and behaviours. SSE is capable of generating the terrain, threats, and models with appropriate behaviours. SSE also supports operation in either a DIS or HLA environment. Host specific tactics and equipment performance can be tailored into SSE through coordination with each individual host.

SSE provides the models and behaviour characteristics for most Armed Forces and a variety of other manufactured equipment, Air Defence functions, and Logistics functions. SSE provides over 200 models of vehicles, weapons effects, tactics, and threats. The models of NATO and other forces include ground vehicles, artillery, tank platoons, dismounted infantry, mines, and fixed wing assets. The behaviour characteristics modelled into SSE have been verified and validated. This ensures that the models and behaviours do not provide an unreal performance edge to any type of equipment or behaviour that could affect the exercise results. SSE provides a user-friendly interface that supports utilization of a host specific language through its user interface.

The CISTC contain several terrain and SSE databases. Terrain databases are usually in CTDB and Open Flight format, for Stealth equipment in MDX format. The terrain databases are correlated with the SSE databases and support the stealth and virtual simulator functions in a SSE exercise. Additional databases may be developed from geo-specific terrain data through coordination with the requesting host. A Stealth viewer capability allows the exercise managers to view any area of the battlefield without impacting the conduct of the exercise. The stealth vehicle can be attached to any equipment to provide that perspective of the operation.

A Data Logger captures exercise events during execution and supports playback for mission evaluation. The After Action Review capability utilizes the data logger information to review critical points in the exercise and discuss "What if" alternatives. The AAR allows the exercise commander to criticize the performance of all functions and establish the preferred response. This leads to improved mission performance.

Through the use of selected commercial equipment and software simulation tools, the CISTC is designed to support evolving capabilities and missions. The basic CISTC is HLA/DIS compliant without significant investments in equipment or software. The modular approach of the CISTC may be utilized to provide future capabilities in the areas of Digital Data Communications, incorporation of live exercises, and Military Operations in Urban Terrain (MOUT). The CISTC can be further advanced through the incorporation of digital communications, evolving CGF capabilities, new databases, and the integration of virtual and live simulations.

The CISTC may also be expanded to cover Command, Control, Communication, Computers and Information (C2) systems and provide the commander and staff with the ability to plan and execute orders rapidly through digital communications. Information from the simulation environment can be captured and converted into a message format compatible with the actual C2 system in use by local forces. The Fixed Tactical Internet is a concept to support training of the war fighters in their digital C2 system in an integrated live and virtual environment. Virtual simulation provides the input for adjacent units utilizing SSE to create the entities and the Situational Awareness Tactical Internet Data Server (SATIDS) provides situational awareness and C2 messaging capability from the virtual to the live.

This capability may be expanded to higher-level operations whenever new simulations are developed, released, and approved for distribution. The CISTC can also be expanded to include additional cells consisting of either site-specific virtual and live simulators or workstations for additional comprehensive operations.

5.0   CONCLUSIONS

Today, the M&S realm has achieved an overlap with the real world wherein simulation information is viewed coincidentally with the real world. Customarily, the military has used live simulation as a primary means of training. Mainly due to high costs of such training and the growing shortage of adequate space for its conduct, constructive simulation and, more recently, virtual simulation have become increasingly important. The convergence of Live (real people and equipment but simulated results), Virtual (Real people but simulated equipment and environment) Constructive (Simulated people, equipment & environment, stimulated by real people) known as LVC simulation, provides the military (and others) with the ability to "mix and match" simulation methodologies to meet both the training objectives of the commander and the constraints (time, space, cost) imposed by the training context. The advances and growth referred to above have resulted in a virtual explosion in the elements and components associated with simulation.

NATO Forces training has in the past usually provided a sound basis for adapting to new operational environments, but each environment should also be evaluated for its specific requirements. Recent experiences in various deployments of NATO, EU or UN military forces have reinforced the need for training specific to Peacekeeping or Peace Support Operations especially in urban setting, while still emphasizing the need for expertise in basic military field craft and skills. Therefore, it is necessary for NATO Military forces to re-evaluate doctrine, organization, training and equipment to make sure that the specific needs of urban operations are met.

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